International Journal of Sciences: Basic and Applied Research (IJSBAR)

ISSN 2307-4531
(Print & Online)

http://gssrr.org/index.php?journal=JournalOfBasicAndApplied

The Content Validity of Assessment Instruments to Measure Analogical-Transfer Ability

Desy Kumala Sari[a]*, Supahar[b]

[a]*Graduate Program of Physics Education, UniversitasNegeri Yogyakarta, Yogyakarta, Indonesia*
[b]*Faculty of Mathematics and Natural Science, Physics Education, UniversitasNegeri Yogyakarta, Indonesia*
[a]*Email: desy.kumala2016@student.uny.ac.id*
[b]*Email: supahar@uny.ac.id*

Abstract

This study aims to develop assessment instruments to measure analogical-transfer ability. This assessment instrument contains the momentum and impulse lesson material physics at the senior high school level. The item consists of 40 multiple choice items and 8 items of description. This instrument is validated by physics education experts, physicists, and educational practitioners. The analysis result using Aiken'V equation. The result of the analysis shows that coefficient ranges between 0.64 to 0.93. The result shows that all of the developed items 'good be used' to measure analogical-transfer ability at the senior high school level.

Keywords: content validity; assessment; analogical-transfer ability.

1. Introduction

The curriculum was the planning that governs to determine the implementation dan learning outcomes. In Indonesia has implemented the Curriculum 2013 which is the new curriculum. This curriculum was applied to all levels of education. The implementation of the Curriculum 2013 focuses on the process of assessing the competence of learners. Achievement of the intended competence is assessed from the learning process and learning progress achieved by learners.

---

* Corresponding author.

Based on Permendikbud number 23 of 2016, assessment results of students in primary and secondary education includes aspects of attitude knowledge and skills. This means that a teacher must have the ability to assess the learning outcomes of learners from the aspect of attitude, knowledge, and skills.

The fact shows that the ability as a teacher in drafting assessment instruments was still low. It was reinforced by the results of research entitled "*activities to go to school professor"* conducted by spreading the questionnaire to the teacher. The result shows that 79% of teachers have difficulty in making assessment instrument [1]. In addition, Reference [2] revealed that only a small proportion of disciplinary teachers are assessed and very few teachers prepare the assessment tool. It was of particular concern to governments and academics.

Assessment in a lesson can be the basis of decision makers [3–5]. Through the assessment, a teacher can conclude the level of ability of individual learners [5,6]. Assessment in the classroom is part of the formative assessment. That was in accordance with Angelo and Cross [7]. According to Moss and [8], in the process of formative assessment teachers and learners should work together in several ways, including: (1) focus on the main objectives of learning, (2) make relevant performance preparations or related to the main objectives of learning, and (3) determine actions to achieve the main objectives of learning. In addition, note that main purpose of formative assessment is to improve learning.

Implementation of assessment in learning can be done by using a variety of assessment tools. Assessment tools in the format of test that are classified into the objective and nonobjective test. The requirement to use an assessment tool that has been declared valid and reliable. Therefore, the design of an assessment tool should consider both aspects. According to [9], the design activities of the test consist of (1) goal setting, (2) blueprint preparation, (3) selecting appropriate grain format, (4) writing the item, and (5) correcting items. The choice of test formats that teachers use should be tailored to the characteristics of the lesson and the abilities to be measured.

The development of an assessment instrument especially in the subject of physics should take in to account its cognitive domain[10] in accordance with the bloom taxonomy. Assessment in physics learning was generally done to determine the ability of conceptual understanding and problem-solving[11]. Problem-solving is the most important learning outcomes in many contexts[12]. One aspect that often becomes the difficulties of learners in physics learning is the analogical transfer. The application of analogical-transfer generally involves some concise principles and concepts in mathematical format[13]. The ability of analogical-transfer greatly helps learners in studying and solving a physics problem[14,15]. The ability of analogical-transfer can be enhanced by doing problem-solving exercises regularly by comparing isomorphic problems[14].

Isomorphic problem was problem pairs constructed from different backgrounds and surface features (language) but has similarities in form, principle, problem-solving steps as well as the difficulty and complexity of the problem. That was in accordance with the opinions of previous research who expressed the similarity of isomorphic problem pairs lies in the background of the problem [14], and different surface features [16,17]. Meanwhile, the difference in the isomorphic question lies in the problem [18], principle [19,20], problem-solving steps [21,22], and also the level of difficulty and complexity of the problem [23].

The purpose of using isomorphic problems in learning to test concepts[19], and similar abilities [23]. In addition, an isomorphic problem can be used to diagnose problem-solving patterns to see the progress of learners[24] and to determine the feedback to be provided[23]. The use of isomorphic problems in addition to measuring certain abilities can also be used to train the ability of learners. One of the benefits to be gained was that learners practice the ability to understand the similarities and differences between problem partners[25]. In addition, Lin and Singh express the benefits of using an isomorphic problem that was learners can develop knowledge[14], skills[15], and improve the ability to transfer knowledge from one context to another[15,25]. Exercise using an isomorphic problem can make it easier for learners to analyze new problems[20] encountered.

The analogical-transfer ability was an ability to transfer familiar problem-solving to solve new problems[26–28]. Analogical transfer activities may continue even though there were differences in features between issues[29]. Although the problem was different, the problem resolution process has the same steps. The application of analogical transfer requires similarity[27], a connection between problem pairs [28]. The similarities were structural relationships[30,31], in the format of methods or procedures used in solving problems[32,33]in addition, it also uses the same principles and concepts. While the connection between the problems useful as an effective guide to solving new problems[28]. The analogical transfer in physics was interested because it only uses principles and concepts developed into concise mathematical forms[15]. A problem once encountered can be used as a source of information. Isomorphic problem was related to the analogical-transfer ability.This study aims to produce the assessment instrument to measure analogical-transfer ability.

2. Material and Methods

In this research, an assessment instrument based isomorphic was developed to measure analogical-transfer ability in physics. The development model used was the 4-D model (Four-D Model). As the name suggests, this 4-D model consists of four stages of research: Define, Design, Develop and Disseminate [34].The research procedure was adapted to the 4-D model steps, so it was developed into 11 research steps including, (1) preliminary study, (2) determining blueprint of instrument, (3) developing instrument, (4) determining scale of the instrument, (5) instrument review, (6) instrument analysis, (7) instrument testing, (8) analysis of instrument test result, (9) improving instrument, (10) measuring, and (11) interpretation of measurement results.

The validity of content assessment instrument in this study used Aiken's Validityanalysis [35], [36], by the equation.

$$V = \frac{\sum s}{n(c-1)} \qquad (1)$$

With "V" is the validity of grains index; "s" is the score that determined each rater that reduced the score the lowest in the category of user ($s = r - l_0$); "r" is the score categories rater choice; "l_0" isthe lowest score in the scoring category; "n" is symbol of total rater; and "c" is the number of categories that may be selected as a rater.Interpretation of the coefficient of validity follows the interpretation byAzwar[36], presented in Table 1.

Table 1: Interpretation of Validity Coefficients

Coefficient of Validity	Interpretation
> 0.35	Very well for used
0.21 – 0.35	Can be used
0.11 – 0.20	Depends on situation
< 0.11	Not well used

3. Results and Discussion

The product developed was assessment instrument based isomorphic problem. Purposes of developing this assessment instruments are to measure the analogical-transfer ability in physics especially for the matter of momentum and impulse. The developed instrument consists of 40 multiple choice question and 8 description questions.

The preliminary study stage was carried out two activities such as teacher competency analysis and material analysis. Purposes of teacher competency analysis were to obtain information related to the assessment commonly used by the teacher. That analysis was done by interviewing some high school physics teachers. The material analysis aims to analyze basic competence in the Curriculum 2013. This research is limited only on the matter of momentum and impulse do that, basic competence is used i.e. 3.10. Applying the concept of momentum and impulse, and the law of conservation of momentum in everyday life. The determining Blueprint of Instrument stage, the blueprint is developed from the basic competence to be used. The momentum and impulse materials are divided into four sub-materials such as the concept of momentum and impulses, the relationship between impulses and momentum changes, the law of conservation of momentum and collision. This sub-material is then developed into 4 item indicators and 13 essential item indicators. Then developed into 40 items of multiple choice questions and 8 items of description. The blueprint of the assessment instrument is presented in Table 2. The developed assessment instrument consisted of 40 items of multiple choice questions and 8 items of description. Taking into account their aspects, including materials, construct dan languages. The material aspect includes material suitability, material completeness, and unit usage. The construct aspect includes the formulation of the item and the use of answer option. While language aspect includes language rules and language logic. The Determining Scale of Instrument stage was developed two forms of the item. Those are multiple choice and description. The score in multiple-choice i.e. 0-1 and description used score 0-4. Item description was adapted to the step of problem-solving. Score 0 if the learner does not answer or answer but wrong. Score 1 if the learners correctly identify the problem. Score 2 if the learners use the strategy correctly. Score 3 if the learners answer applying strategy correctly. Score 4 if the learners give the conclusion. The Assessment instrument was reviewed by 7 expert judgments consisting of 2 physics material experts, 1 physics teacher, and 4 peer reviewers who are postgraduate physics education students. The result of the assessment instrument was analyzed using Aiken Validity equation to obtain the validity coefficient.

Table 2: Blueprint of the assessment instrument

Basic Competencies	Sub-Material	Item Indicators	Essential Item Indicators
3.10 Applying the concept of momentum and impulse, and the law of conservation of momentum in everyday life.	The concept of momentum and impulses	Determining physics quantities uses the concept of momentum and impulses	Presented data related to a style object, learners can determine the amount of which is not yet known
			Presented data on moving objects, learners can determine one of the unknown quantities
			Presented graphs of the relationship between force and time, learners can determine unknown quantities
	The relationship between impulses and momentum changes	Determining physical quantities use the concept of the relationship between impulses and momentum changes	Presented data about an object that falls from a certain height, learners can determine one of the unknown quantities
			Presented data about an object thrown then bounces, learners can determine one of the unknown quantities
			Presented data on an object being beaten, learners can determine one of the unknown quantities
	The law of conservation of momentum	Analyze an event in everyday life using the concept of conservation of momentum	Presented data on two objects that are moving then collide with each other, learners can determine one of the unknown quantities
			Presented data about an object that bump into another object, learners can determine one of the unknown quantities
			Presented data about an object being shot, learners can determine one of the unknown quantities
			Presented data on moving boats, learners can determine any unknown quantities
	Collision	Analyzing collusion events	Presented data about the object that fall then experience reflection, learners can determine the height of object after reflected
			Presented data about the object that fall then experience reflection, learners can determine the coefficient of restitution object
			Presented data on the collision event of two objects, learners determine the final speed of the object

Assessment instrument was reviewed by 7 reviewers by considering the material, construct, and language aspect. The conclusions of the study of each item were then analyzed using the Aiken Validity equation to measure the validity coefficient (V).

The obtained coefficient of validity was interpreted in Table 1. The Coefficient of validity obtains from the resulting study of 40 items of multiple choice questions and 8 item of description is ranged from 0.64 to 0.93. This indicates that the overall questions item are very well for used categories. Thus, the whole item of the questions otherwise fulfilled the validity of content. Assessment instrument to measure analogical-transfer ability was revised with reference to the reviewers' suggestions, improvements in the grammar and the use of optional answer. The suggested answer option has a homogeneous length and sorted length.

4. Conclusion

The conclusions of this study were as follows: (1) development of assessment instrument to measure analogical transfer ability following the research and development stage, (2) development of assessment instrument to measure analogical-transfer ability has a value of validity coefficients ranging from 0.64 to 0.93 which means that the whole grain of the developed instrument is in the category very well for use. The developed assessment instrument is expressed in the material, construct and language aspect. In addition to knowing the value of the validity coefficient, validity aims to get suggestions used as an instrument to consider before trial in school.

References

[1] Rohmawati, "Kurikulum 2013, 87 persen guru kesulitan dalam cara penilaian," www.unnes.ac.id, 2013.

[2] B. Kartowagiran and A. Jaedun, "Model asessmen autentik untuk menilai hasil belajar siswa sekolah menengah pertama (SMP): Implementasi assessmen autentik di SMP," J. Penelit. dan Eval. Pendidik., vol. 20, no. 2, pp. 131–141, 2016.

[3] A. J. Nitko, Educational assessment of student, 6th ed. Boston: Pearson, 2011.

[4] J. Hartig, E. Klieme, and D. Leutner, Assessment of competencies in educational context. Hogrefe Publishing, 2008.

[5] C. R. Reynolds, R. B. Livingston, and V. Willson, Measurement and assessment in education, 2nd ed. USA: Pearson, 2009.

[6] D. H. Schunk, Learning Theories an Educational Perspective, 6th ed. Boston: Pearson Education, 2012.

[7] T. A. Angelo and K. P. Cross, Classroom assessment techniques, a handbook for college teachers. San Fransisco: Jossey-Bass Publisher, 1993.

[8] C. M. Moss and S. M. Brookhart, Advancing formative assessment in every classroom: a guide for instructional leaders. Alexandria: VA: ASCD, 2009.

[9] L. L. Oriondo and A. Dollo, Evaluation educational outcomes (test, measurement, and evaluation). Quezon City: REX Printing Company, Inc, 1984.

[10] P. Barniol and G. Zavala, "Test of understanding of vectors: a reliable multiple-choice vector concept test," Latin-American J. Phys. Educ., vol. 10, pp. 1–14, 2014.

[11] T. Palm, "Performance assessment and authentic assessment: a conceptual analysis of the literature," Pract. Assessment, Res. Eval., vol. 13, no. 4, pp. 1–11, 2008.

[12] D. H. Jonassen, Learning to Solve Problems: A Handbook for Designing Problem-Solving Learning Environment. New York: Routledge, 2011.

[13] C. Singh, "Assessing student expertise in introductory physics with isomorphic problems . I . Performance on nonintuitive problem pair from introductory physics," Phys. Educ. Res., vol. 010104, no. 4, pp. 1–9, 2008.

[14] S. Lin and C. Singh, "Using isomorphic problems to learn introductory physics," Phys. Educ. Res., vol. 020104, no. 7, pp. 1–16, 2011.

[15] C. Singh, "Assessing student expertise in introductory physics with isomorphic problems . II . Effect of some," Phys. Educ. Res., vol. 010105, no. 4, pp. 1–10, 2008.

[16] S. Y. Lin and C. Singh, "Using an isomorphic problem pair to learn introductory physics: Transferring from a two-step problem to a three-step problem," Phys. Rev. Spec. Top. - Phys. Educ. Res., vol. 9, no. 2, pp. 11–19, 2013.

[17] M. De Cock, "Representation use and strategy choice in physics problem solving," Phys. Rev. Spec. Top. - Phys. Educ. Res., vol. 020117, no. November, pp. 1–15, 2012.

[18] K. Scheiter, P. Gerjets, and J. Schuh, "The acquisition of problem-solving skills in mathematics : How animations can aid understanding of structural problem features and solution procedures," Instr. Sci., pp. 487–502, 2010.

[19] D. Zingaro and L. Porter, "Computers & Education Peer Instruction in computing : The value of instructor intervention," Comput. Educ., vol. 71, pp. 87–96, 2014.

[20] B. R. Rush et al., "The Effect of Differing Audience Response System Question Types on Student Attention in the Veterinary Medical Classroom," J. Vet. Med. Educ., vol. 37, no. 2, pp. 145–153, 2010.

[21] H. A. Simon and J. R. Hayes, "The understanding process: Problem isomorphic," Cogn. Psychol., vol. 8, no. 2, pp. 165–190, 1976.

[22] J. R. Hayes and H. A. Simon, Cognitive Theory. Lawrence Erlbaum, Hillsdale, 1977.

[23] E. Kjolsing, S. M. Asce, L. Van Den Einde, D. Ph, and M. Asce, "Peer Instruction : Using Isomorphic Questions to Document Learning Gains in a Small Statics Class," Comput. Educ., pp. 1–8, 2014.

[24] N. Khasanah and L. Yuliati, "Problems in dynamics of rational motion topic," J. Pendidik. IPA Indonesia., vol. 5, no. 2, pp. 186–191, 2016.

[25] S. Lin and C. Singh, "Using an isomorphic problem pair to learn introductory physics : Transferring from a two-step problem to a three-step problem," Phys. Educ. Res., vol. 020114, no. 9, pp. 11–19,

2013.

[26] J. L. Docktor and J. P. Mestre, "Synthesis of discipline-based education research in physics," Phys. Educ. Res., vol. 020119, no. 10, pp. 1–58, 2014.

[27] C. E. Stevenson, W. J. Heiser, and W. C. M. Resing, "Working memory as a moderator of training and transfer of analogical reasoning in children," Contemp. Educ. Psychol., vol. 38, no. 3, pp. 159–169, 2013.

[28] B. C. Storm and D. C. Bui, "Individual differences in mind wandering while reading predict lower rates of analogical transfer," Learn. Individ. Differ., vol. 51, pp. 427–432, 2016.

[29] M. B. Casale, J. L. Roeder, and F. G. Ashby, "Analogical transfer in perceptual categorization," Mem. Cognit., vol. 40, no. 3, pp. 434–449, 2012.

[30] M. S. Gary, R. E. Wood, and T. Pillinger, "Encahcing mental models, analogical transfer dan performance in strategic decision making," Acad. Manag. J., vol. 51, no. 2, pp. 315–334, 2008.

[31] J. A. Kaminski, V. M. Sloutsky, and A. F. Heckler, "The cost of concreteness: The effect of nonessential information on analogical transfer.," J. Exp. Psychol. Appl., vol. 19, no. 1, pp. 14–29, 2013.

[32] D. T. Brookes, B. H. Ross, and J. P. Mestre, "Specificity, transfer, and the development of expertise," Phys. Rev. Spec. Top. - Phys. Educ. Res., vol. 7, no. 1, pp. 1–8, 2011.

[33] K. J. Holyoak and K. Koh, "Surface and structural similarity in analogical transfer," Mem. Cognit., vol. 15, no. 4, pp. 332–340, 1987.

[34] S. Thiangrajan, S. S. Dorothy, and I. S. Melvyn, Instructional development for training teaacher of exceptional children. Minnesota: Indiana University, 1974.

[35] L. R. Aiken, "Three coefficients for analyzing the reliability and validity of ratings," Educ. Psychoological Meas., no. 45, pp. 131–142, 1985.

[36] S. Azwar, Reliabilitas dan Validitas, IV. Yogyakarta: Pustaka Pelajar, 2015.